Bonneville Power Administration
Fish and Wildlife Program FY2000 Proposal Form

PART I - ADMINISTRATIVE
Section 1. General administrative information

Title of project	
Restore Moses Lake Recreational Fishery	
BPA project number	**9502800**
Contract renewal date (mm/yyyy)	**10/1999**
Multiple actions? (indicate Yes or No)	
Business name of agency, institution or organization requesting funding	
Washington Department of Fish and Wildlife	
Business acronym (if appropriate)	**WDFW**
Proposal contact person or principal investigator:	
Name	**Joe Foster**
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NPPC Program Measure Number(s) which this project addresses	
10.8B.19 Resident fish substitution for lost anadromous fish production and recreational opportunities above Chief Joseph and Grand Coulee dams.	
FWS/NMFS Biological Opinion Number(s) which this project addresses	
N/A	
Other planning document references	
N/A	
Short description	
Restore/enhance the failed recreational fishery for resident species in Moses Lake, once the premier fishery for resident game fish in the Columbia Basin, in lieu of lost recreational fishery opportunities for anadromous game fish species in the upper Columbia River.	
Target species	

Black Crappie, Bluegill, Yellow Perch, Rainbow Trout, Largemouth Bass, Walleye, Smallmouth Bass

Section 2. Sorting and evaluation

Subbasin
Systemwide

Evaluation Process Sort

CBFWA caucus		**CBFWA eval. process**		**ISRP project type**	
X one or more caucus		If your project fits either of these processes, X one or both		X one or more categories	
	Anadromous fish	X	Multi-year (milestone-based evaluation)		Watershed councils/model watersheds
X	Resident Fish		Watershed project eval.		Information dissemination
	Wildlife				Operation & maintenance
					New construction
				X	Research & monitoring
				X	Implementation & mgmt
					Wildlife habitat acquisitions

Section 3. Relationships to other Bonneville projects

Umbrella / sub-proposal relationships. List umbrella project first.

Project #	**Project title/description**

Other dependent or critically-related projects

Project #	**Project title/description**	**Nature of relationship**
9700400	Resident Fish Stock Status above Chief Joseph and Grand Coulee Dams	Information exchange/blocked area coordination.

Section 4. Objectives, tasks and schedules

Past accomplishments

Year	Accomplishment	Met biological objectives?
FY99	**Objective 1:** Synthesize all current information on Moses Lake. **Task** 1.1 Review existing information on the fisheries and ecology of Moses Lake. **Task** 1.2 Analysis of previously collected data. A. Bring database up to date B. Examine previously collected fish scales for age and growth data C. Analyze database (over 10,000 entries)	Complete reference library. Complete and current database. Summary of the history of Moses L. Identify past fish population trends. Identify further data needs.
	Objective 2: Data collection. **Task** 2.1 Continued collection of baseline information. **Task** 2.2 Preliminary surveys suggested by initial literature and data analysis. **Task** 2.3 Collect water quality, habitat and fisheries information currently unavailable, but required for limiting factor assessment.	Equipment procured. Additional data collected.
	Objective 3: Formulate a detailed study plan. **Task** 3.1 Develop hypotheses as to what factors are currently limiting the production and recruitment of bass, crappie, bluegill, perch and trout to the recreational fishery. **Task** 3.2 Develop and test methodology to test the hypotheses. **Task** 3.3 Incorporate several ongoing projects on Moses Lake for continuity.	Detailed study plan for FY 2000-02. - Formulation of hypotheses - Methodology tested. - Include ongoing projects.

Objectives and tasks **- FY2000**

Obj 1,2,3	Objective	Task a,b,c	Task
1	Collect the data outlined in the study plan developed in FY 99 as necessary to understanding fish population dynamics in Moses Lake and to test the hypotheses.	**a**	Collect biological data, including population estimates, age and size distribution, food consumption and predation rates, and standing crop estimates for all major fish species.
		b	Assess the availability and current use of spawning and rearing habitat for all major fish species.
		c	Collect detailed hydrological and limnological information during all periods of the year for two years.

Obj 1,2,3	Objective	Task a,b,c	Task
		d	Monitor angling effort and harvest.
		e	Identify and implement management measures during the data collection phase if it is likely that subsequent results would test hypotheses or if longer monitoring periods are desirable.
2	Develop management actions based on valid hypotheses which will result in restoring the desired fish populations to Moses Lake.	**a**	Identify the true hypotheses.
		b	Devise management measures to effect the needed changes suggested by the true hypotheses.

Objective schedules and costs - FY2000

Obj #	Start date mm/yyyy	End date mm/yyyy	Measureable biological objective(s)	Milestone	FY2000 Cost %
1	10/1999	12/2002	Complete biological profile of all major fish species.		60
			Habitat map detailing important production areas and current use.		20
			Complete nutrient, water and thermal budget profiles.		20
2	10/2001	12/2002	Results of management measures instituted during the data collection period.		
			Comprehensive fish management and enhancement plan for Moses Lake.	Determines management endeavors to be instigated and evaluated during Phase 3 of the project.	
				Total	100%

Schedule constraints

FY 2000 Tasks may be modified, added to or deleted depending on the final plan resulting from Objective 3 in FY 1999. As the necessary information becomes available, management actions in Objective 2 - FY 2000 which could be implemented earlier than 10/2001 may become apparent. These actions will be implemented if it is likely that 1) the subsequent results would test a hypothesis, or 2) if it would be beneficial to begin monitoring an action before Phase 3 commences because a longer evaluation is desirable.
Completion date FY 2004

Section 5. Budget

FY99 project budget (BPA obligated):	$**266,000**

FY2000 budget by line item

Item	Note	% of total	FY2000 ($)
Personnel	Includes one Fish Biologist 3 @ $45,996 and two Fish Biologist 1's each @ $33,372	48.0	112,740
Fringe benefits	Includes one Fish Biologist 3 @ $11,240 and two Fish Biologist 1's each @ $9,327	12.7	29,894
Supplies, materials, non-expendable property	Goods and Services	7.2	16,910
Operations & maintenance	N/A		
Capital acquisitions or improvements (e.g. land, buildings, major equip.)	Equipment includes a Hydrolab @ $10,307; Boat, Trailer, and Motor @ $12,000; and Fyke Nets @ 1,482	10.1	23,789
NEPA costs	N/A		
Construction-related support	N/A		
PIT tags	# of tags: N/A		
Travel	Mileage and per diem	3.4	8,040
Indirect costs	WDFW Overhead (20% on all items except equipment listed under Capital acquisitions.	14.3	33,517
Subcontractor	N/A		
Other	Enhancement Project Account - funding for future enhancements identified during the course of the investigation (e.g. fish barriers, habitat manipulations, broodstock)	4.3	10,000
	TOTAL BPA REQUESTED BUDGET		234,890

Cost sharing

Organization	Item or service provided	% total project cost (incl. BPA)	Amount ($)
N/A			
		Total project cost (including BPA portion)	234,890

Outyear costs

	FY2001	FY02	FY03	FY04
Total budget	213,101	217,902	222,702	227,502

Section 6. References

Watershed?	Reference
	Bain, Richard C.. 1987. Moses Lake clean water project; final stage 3 report. Moses Lake Irrigation and Rehabilitation District. Moses Lake, Washington.
	Bush, Ronald M. and Eugene B. Welch. . Plankton associations and related factors in a hypereutrophic lake. U.W. Civil Engineering. Seattle, Washington.
	Chadwick, Patrick A. Jr., Brian J. Davies, Tammy K. flowers, James Walton and Will Wirt. 1985. Moses Lake fish population analysis. Peninsula College. Port Angeles, Washington.
	Duff, Raymond L.. 1976. A year's survey of the Moses Lake fishery. Washington Department of Game. Olympia, Washington.
	Eads, Rex, Tom Sibley, Rafael Ponce and Vivian Peterson. 1991. Economic impact and environmental assessment of the decline of fishing, Moses Lake and Potholes Reservoir. Big Bend Economic Council. Ephrata, Washington.
	Fletcher, Doug, Molly Hallock and Kurt Perry. 1987-1993. 7 vol.. Warmwater fishing contests in Washington. Washington Department of Wildlife. Olympia, Washington.
	Groves, Kenneth E.. 1951. Fishes of Moses Lake, Washington. Walla Walla College. College Place, Washington.
	Jackson, Stephan Y.. 1985. 1983 Moses Lake creel census. Washington Department of Game. Olympia, Washington.
	Korth, Jeffrey W.. 1992. 1991 Moses Lake creel census. Washington Department of Fish and Wildlife. Olympia, Washington.
	Korth, Jeffrey W.. 1993-1998. 6 vol.. Fisheries management annual report. Washington Department of Fish and Wildlife. Olympia, Washington.
	Northwest Power Planning Council. 1995. Columbia River Basin Fish and Wildlife Program - Resident Fish and Wildlife Ammendments. Northwest Power Planning Council. Portland, Oregon.
	Sylvester, Robert O. and Ray T. Oglesby. 1964. The Moses Lake water environment. U.W. Civil Engineering. Seattle, Washington.
	Upper Columbia Fisheries Managers. 1998. Upper Columbia blocked area management plan. Spokane, Washington.
	Welch, Eugene B., James Buckley and Ronald M. Bush. 1971. Dilution as a control for nuisance algae blooms. U.W. Civil Engineering. Seattle, Washington.
	Walton, James M. and Will Wirt. 1989. Fish population assessment of four eastern Washington lakes. Peninsula College. Port Angeles, Washington.
	Zook, William. 1976, 1977. 2 vol.. Fisheries management annual report. Washington Department of Game. Olympia, Washington.
	Zook, William. 1978. Warmwater fisheries research in Washington. Washington Department of

	Game. Olympia, Washington.

PART II - NARRATIVE

Section 7. Abstract

Restore/enhance the failed recreational fishery for resident game fish species in Moses Lake in lieu of lost recreational fishery opportunities for anadromous game fish species in the upper Columbia River. Moses Lake was once the premier fishery for resident game fish in the Columbia Basin. Beginning in the late 1970's, these fisheries experienced a steady decline due to a number of events. Some of the causes have been tentatively identified, such as changes in species composition, recreational angling, and habitat conditions; however, the individual impacts and interactions of these events are less well understood. The lack of both manpower and proper equipment has stymied efforts to evaluate these impacts and identify measures designed to reverse current trends.

WDFW proposes to restore the fishery through the systematic investigation of the individual aspects of the current situation (e.g. harvest, species diversity and abundance, recruitment, predator-prey relationships, primary productivity, habitat types and availability). This will enable the identification of those aspects which have the greatest impacts on the fishery and which are capable of being manipulated. The methods to do so can then be designed and implemented.

In the first year (FY 99) of the six year project, the assessment of all currently available information and the development of a detailed study plan to test hypotheses explaining the factors limiting the development of the desired fisheries will be completed. FY 2000 will be the first year of intensive field investigation per the detailed study plan being developed in FY 99.

Section 8. Project description

a. Technical and/or scientific background

Moses Lake is the third largest natural lake in Washington and represents an invaluable asset for wildlife and fisheries propagation and recreational interest. It is part of the Crab Creek drainage to the Columbia River and was connected to the Columbia Basin Reclamation Project in the 1950's. Moses Lake is heavily influenced by irrigation transport and return flows and has been slightly enlarged and stabilized by the construction of outlet control structures. The lake currently covers 6,800 acres, inundates 120 miles of shoreline, and is 16 miles long.

Moses Lake was once the premier fishery for resident fish species in central Washington. The USFWS initially stocked fish in the lake during the 1930's and 1940's, and fisheries for black crappie, bluegill, and yellow perch were quickly established (Groves 1951). Crappie began to dominate the fishery by the mid-1960's and continued as such until the early 1980's. The first indications of this species' decline in total harvest appeared during 1969-1974; however, crappie

still constituted three-quarters of the harvest during 1974, with bluegill and perch making up most of the remaining game fish harvest (Duff 1976). Seventy-five percent of the angling effort during this time was for spiny-rayed species even though the Washington Department of Game had begun stocking the lake with rainbow trout during the 1960's.

Surveys during the mid to late 1970's indicated further declines in the total harvest of crappie and bluegill (Zook 1976, 1977, 1978). Washington Department of Fisheries data indicated that commercial carp harvest, at peak levels during the heyday of crappie harvest, was also falling sharply due to failing market conditions during this period. By 1983, crappie and bluegill harvest together was only one-third of the catch, and perch and trout contributed about equally to the remaining harvest (Jackson 1985). While the total angling effort had doubled since 1974, total harvest had only increased two percent, and almost half of the angling effort was now focused on trout. Walleye harvest was also documented for the first time during the creel survey in 1983. Walleye had not been stocked in Moses Lake previous to this survey, and this species likely entered the lake from the Columbia River through the irrigation system.

Largemouth and smallmouth bass had always accounted for a relatively small percentage of the harvest in Moses Lake. Relative abundance of these species actually increased until the mid 1980's, but declined thereafter. Perhaps the best evidence that bass species were also on the decline came from tournament data. The years 1987-90 averaged only seven organized club events per year and only 81 fish per event (Fletcher et al, 1987-93). Fewer events have been held during the 1990's. Smallmouth bass appear to have largely displaced the largemouth bass in Moses Lake, although there was some evidence that smallmouth bass were only holding their own and that largemouth bass had suffered the majority of the decline as concerns bass species.

Surveys through the remaining years of the 1980's continued to document declines in the crappie and bluegill populations (Chadwich, et al 1985; Walton 1988). By the end of the decade and early 1990's, even perch and the stocked rainbow trout were contributing little to the fishery (Eads, et al 1991; Korth, 1992). Carp and bullheads were noted as the lake's dominant inhabitants. Walleye continued to increase in numbers during the early to mid 1990's and were eventually established as the dominant predatory species in Moses Lake (Korth, 1992-1998).

Clearly, the face of the Moses Lake fishery has changed. The coveted panfish fisheries were gone and rainbow trout survival severely limited. The expanding walleye fishery has failed to account for even a small portion of the former harvest or recreational opportunity that these other fisheries produced, as would be expected from a predator dominated fishery.

While some evidence of cause and effect might have been deduced from the changing species and abundance data described, other changes were also occurring to the lake itself, and these changes to habitat conditions were less obvious and the effect on the fisheries was far less well understood. Water quality data has been routinely and voluminously collected by several State and Federal agencies and others (Bush; Eads, et al 1991; Sylvester 1964; Welch 1971). In addition, the rapid shoreline development on Moses Lake and the resultant habitat losses were cause for rescinding the nationwide shorelines permit for this water.

Nutrient loads in Moses Lake and the accompanying algae and plant growth have been a problem

for over four decades. Studied since the 1960's, the most extensive work to date was initiated by the Moses Lake Irrigation and Rehabilitation District (MLIRD 1987). Despite MLIRD's instigating several successful projects to reduce nutrient loading in Moses Lake, the Washington Department of Ecology continued to list water quality as severely impaired by high levels of phosphorous.

Yet the relationships of these many factors have never been synthesized, nor has this information been correlated with any extensive study of the fisheries. An extensive database on species biology remained unanalyzed with much of the data in its raw form. Current fisheries management tactics included the continued stocking of rainbow trout combined with net pen rearing and stocking crappie broodstock in an artificially isolated portion of the lake. Evaluation of these measures has been minimal.

The State's ability to provide angling opportunity for native fishes has continued to decline, in large part due to the changing face of the habitats in which those fishes reside. Besides the lost opportunities in the blocked area, anglers are currently faced with the loss of fisheries on the upper Columbia River associated with the ESA mandated listings or potential listings of other species including steelhead, spring chinook, bull trout, and possibly westslope cutthroat. As these species are listed or their status is scrutinized, other associated fisheries are also lost due to their proximity to the listed populations and the potential for anglers to impact the listed populations. Those waters and habitats which are best suited to the propagation of non-native fisheries and where those non-native fishes have little or no impact on native fish resources should be developed as a substitute for those native natural resources. The non-native fisheries also act as a buffer to continued angling pressure on unlisted native stocks.

Changing demographics in the northwest have placed a premium on these non-native fisheries. The human population expanded in part due the immigration from regions of the United States where warmwater species were native, and preference for warmwater species among the northwest's anglers continued to increase. Anglers local and statewide have supported this project, and much of the work to date has been made possible by the continued use of volunteers. The Central Washington Fish Advisory Committee, a grassroots organization representing many angling groups and other social and economic concerns, has been instrumental in keeping the restoration of Moses Lake's fishery on WDFW's agenda. During 1991, the value of the fishery was only $1.6 million to the State's economy, compared with $4.5 million (1991 dollars) in 1983. The proposed research investment and the cost of whatever enhancement measures are likely to be prescribed would be recouped within several years after the fishery is restored.

WDFW has committed to the restoration of the Moses Lake fisheries, and has continued relatively limited but regular surveys on the lake with the assistance of volunteers since 1991. WDFW has the experience necessary to identify the potential limitations on the fishery and devise the methodology to overcome these obstacles. Managers familiar with the project are confident in its success, but recognize the enormity of the undertaking. Only the lack of professional manpower and equipment have precluded a full scale review and investigation of the many potential causes of the fisheries decline and continued lack of production. Analysis of even the data at hand, voluminous in itself, has been beyond the Department's priorities.

It has remained unlikely that WDFW would have the resources necessary for this investigation or implementation of enhancement measures in the for-seeable future. To rectify that situation and assure that this project is accomplished in a timely manner, the following proposal has been submitted to the Columbia River Basin Fish and Wildlife Program.

Overall Project Plan and Rational:

Phase 1, completed in FY-99, will include an assessment of all currently available information, collection of additional baseline fish population and habitat information, and the development of a detailed study plan to test hypotheses which define the factors limiting the production of the desired fisheries. Current management practices and fisheries improvement schemes will be incorporated into the study plan.

Rationale: When this project was first proposed in 1991, WDFW began a limited biological survey of Moses Lake to collect baseline information for future use. Currently, this data set includes preliminary information from 1991 through 1998; however, the database has not been completely updated or analyzed. In addition, other agencies have gathered considerable information on water quality and water management which date back at least to the 1950's. There is also much anecdotal historical information on the lake and its fisheries. This information has never been synthesized, and it will be considered in the development of the study plan. Initial analysis will direct further data collection which would also be used to refine the study plan and develop the hypotheses. Collection of baseline information will continue, and there are several ongoing projects on Moses Lake which will be incorporated into this proposal for continuity.

Phase 2, FY-00 through FY-02, will implement the study plan, collecting specific information on fish populations, water quality, habitat availability and use, predator-prey relationships, and both inter- and intraspecific competition which test the hypotheses developed during Phase 1. During this phase, measures to improve the fisheries will be identified and may even be implemented provided the measures do not significantly disrupt ongoing evaluations.

Rationale: Biological data already collected will provide baseline information for relative abundance, age and growth rates, young of the year production, and recruitment for key species. This data collection will be expanded in order to monitor and evaluate fluctuation and trends over time. The methodology developed in Phase 1 to collect information on species interactions, standing crop, relationships to habitat, and other species or age classes not well represented in the current database (e.g., whitefish or perch greater than 2 years of age) will be implemented to test the hypotheses.

Data analysis will keep pace with the collection of new data. As the necessary information becomes available, management actions which could be implemented immediately may become apparent. These actions will be implemented if it is likely that 1) the subsequent results would test a hypothesis, and/or 2) if it would be beneficial to begin monitoring an action before Phase 3 commences because a longer evaluation is desirable.

Phase 2 will culminate with the synthesis of all previously gathered data and development of management actions or options based on the true hypotheses and necessary to restore a

productive recreational fishery in Moses Lake.

Phase 3, FY-03 and FY-04, will involve the implementation of management actions or options derived during Phases 1 and 2. Assessment of these and any previously instituted actions will continue as implementation is completed.

Rationale: Once management actions have been implemented, their effects must be monitored to evaluate the relative success of each measure. As a result of continual data analysis during Phase 2, it is anticipated that actions such as regulation changes or fish stocking will be in place early in Phase 3 and will have the benefit of a full two years of monitoring during Phase 3. Actions such habitat manipulation, which involve construction, permits, or other requirements which may result in implementation delays, will be monitored at least through FY-04. The end of Phase 3 will also discern the advisability of further monitoring.

b. Rationale and significance to Regional Programs

The proposal to restore the resident fisheries of Moses Lake is off-site substitute mitigation for the loss of anadromous species in the blocked portion of the Columbia River due to hydropower development (Chief Joseph and Grand Coulee projects). Repair of this valuable fishery would mitigate some of the resource and associated recreation lost specifically to the residents of Grant County and to the State of Washington as a whole. This project would provide 150-200,000 additional days of recreational angling annually within an hours drive of the impacted area.

The Council has stated that resident fish substitution measures mitigating for lost anadromous opportunity in the blocked area shall be among the highest priorities (Section 10.1, and 10.8; Northwest Power Planning Council 1995). Among resident fish substitution measures, high priority should be accorded to those measures affecting important fisheries, including introduced (non-native) species (10.1B). The Council specifically recognized that angling pressure on resident fish species in the Columbia Basin has increased significantly due to the loss of anadromous angling opportunity. High priority should also be given the proposal due to the off-site nature of the proposal, because the Moses Lake fishery can be restored without adversely affecting other anadromous or resident fish populations or mitigation (10.1B). Thus, consumptive fisheries for resident game fish in Moses Lake are properly substituted for the loss of anadromous fish and recreational opportunity in the blocked area.

While Moses Lake and its fisheries have little or no biological impact to the Columbia River, the converse has not been true. Moses Lake has been greatly influenced by the Columbia River and its fisheries, primarily due to direct tie-ins with the irrigation system of the Columbia Basin Reclamation Project. Seasonal fluctuations in water retention times and thus temperatures and productivity, are influenced by water management at Potholes Reservoir because the most direct route for incoming water to Potholes is through Moses Lake. It is more than likely that walleye from FDR were and continue to be introduced to Moses Lake by this connection. Therefore, resident fish substitution in Moses Lake is not as far from the site of loss as it may seem.

Finally, the proposal has the support of both state and tribal fisheries managers in the blocked area (Upper Columbia Fisheries Managers, 1998).

c. Relationships to other projects

The Moses Lake proposal provides a way to the means for managing the Moses Lake fisheries within the framework of the realities of the Reclamation Project and hydropower considerations. It is likely that the biological objectives concerning the management of resident fish identified for the Moses Lake project will have application to other reservoir fisheries in the region, including reservoirs on the main-stem Columbia River, which may enhance the management of both resident and anadromous fisheries therein. The proposal includes the development of specific rebuilding schedules and associated monitoring programs (10.1C).

Moses Lake is also among the many waters in the Columbia Basin included in Project 9700400 which seeks and compiles information on the status of resident fish stocks in the Columbia Basin.

The Moses Lake project will be closely coordinated with the U. S. Bureau of Reclamation, Corps of Engineers, the Warmwater Enhancement Program of the WDFW, the Washington Department of Ecology, the Moses Lake Irrigation and Rehabilitation District, and the City of Moses Lake.

d. Project history (for ongoing projects)

The Moses Lake Fishery Restoration Project was adopted into the Columbia Basin Fish and Wildlife Program in 1992. The project first rated high enough by the Resident Fish Committee to be eligible for funding during FY98. Initial funding of $52,000 was increased to $286,000 (full funding) in FY98; however, delays in implementation prevented spending until the current (FY99) budget cycle. In FY99, the project was again fully funded at $266,000. Spending for salaries and most equipment appropriation will be completed by the end of FY99.

Accomplishments expected by the end of FY99 include the completion of Phase 1, an assessment of all current information and the development of a detailed study plan**.** The major results achieved will include: A. Complete reference library, B. Complete and current database, C. Summary of the history of Moses Lake, D. Equipment procured, E. Methodology tested, and F. Detailed study plan for FY2000-02, wherein the hypotheses as to what factors are currently limiting the fishery in Moses Lake are developed.

e. Proposal objectives

Phase 1 - Assessment of all current information and the development of a detailed study plan**.**
Objective 1: Synthesize all current information on Moses Lake.
Objective 2: Data collection.
Objective 3: Formulate a detailed study plan, wherein the hypothe**ses** as to what factors are currently limiting the fishery in Moses Lake are stated (e.g. Hypotheses, among many: 1. Young

of the year carp dominate the productivity of Moses Lake during the spring and early summer and out-compete the young of the year of the desired species; 2. Lack of adequate rearing habitat exists to protect young fishes from predators; 3. Primary productivity in Moses Lake is tied up in undesirable algae blooms and unavailable to the food chain; 4. Angler harvest suppresses recruitment to mature age classes).

Schedule: January 1, 1999 - December 31, 1999

Products:
A. Complete reference library.
B. Complete and current database.
C. Summary of the history of Moses Lake.
D. Identify past fish population trends.
E. Identify further data needs.
F. Equipment procured.
G. Methodology tested.
H. Detailed study plan for FY 2000-02.
- Formulation of hypotheses
- Methodology tested.
- Include ongoing projects.

Phase 2 - Determine the most feasible measures for attaining desirable fish populations and restoring the fishery in Moses Lake.

Objective 1: Collect the data outlined in the study plan as necessary to understanding fish population dynamics in Moses Lake and to test the hypotheses.

Objective 2: Develop management actions based on valid hypotheses which will result in restoring the desired fish populations to Moses Lake. (i.e. identify true hypotheses and the appropriate management actions suggested by true hypotheses).

Schedule: January 1, 2000 - December 31, 2002

Products:
A. Complete biological profile of all major fish species.
B. Habitat map detailing important production areas and current level of use.
C. Complete nutrient, water and thermal budget profiles.
D. Summary of the results of any management measures instituted during the data collection period.
E. Comprehensive fish management/enhancement plan for Moses Lake.
F. Complete and current database.

Phase 3 - Implement management measures as prescribed in the comprehensive plan to restore recreational angling opportunities for bass, crappie, bluegill, perch and trout in Moses Lake.

Objective 1: Implement habitat improvement, population control and/or regulatory measures required to restore fisheries for target species.

Objective 2: Monitor fish population and habitat response to management intervention and utilize principles of adaptive management to achieve objectives.

Objective 3: Evaluation of the success of management actions, and a management plan for the future management of Moses Lake.

Schedule: January 1, 2003 - December 31, 2004

Products:
A. Effective fisheries enhancement measures, resulting in increased production and recruitment of targeted species and improved recreational angling.
B. Updated comprehensive fish management/enhancement plan for Moses

Lake, based on the results of measures success to date.
C. Recommendations for additional measures or further monitoring.
D. Complete and current database.
E. Increasing levels of recreational angling opportunity and catch, approaching the target of 1970's-80's levels.

f. Methods

Phase 1 - Assessment of all current information and the development of a detailed study plan. This will include a complete review of all historic and current information on the fish populations, ecology, and limnology of Moses Lake. The information will be critically evaluated to determine if there are any obvious correlations between changes in any of these factors. The assessment may require that additional new data be collected for comparative purposes.

Objective 1: Synthesize all current information on Moses Lake.

Task 1.1 Review existing information on the fisheries and ecology of Moses Lake.

Task 1.2 Analysis of recently collected data.

A. Bring database up to date
B. Examine previously collected fish scales for age and growth data
C. Analyze database (over 10,000 entries)

Objective 2: Data collection.

Task 2.1 Continued collection of baseline information.

Task 2.2 Preliminary surveys suggested by initial literature and data analysis.

Task 2.3 Collect water quality, habitat and fisheries information currently unavailable, but required for limiting factor assessment.

Objective 3: Formulate a detailed study plan.

Task 3.1 Develop hypotheses as to what factors are currently limiting the production and recruitment of bass, crappie, bluegill, perch and trout to the recreational fishery.

Task 3.2 Develop and test methodology to test the hypotheses.

Task 3.3 Incorporate several ongoing projects on Moses Lake for continuity.

NOTE: The following Tasks listed for Phase 2 are currently anticipated, but may be modified based on the results of Phase 1. Greater detail for given tasks will be included in the study plan developed in FY99. Tasks for Phase 3 will be developed after the proper management measures have been identified at the culmination of Phase 2.

Phase 2 - Determine the most feasible measures for attaining desirable fish populations and restoring the fishery in Moses Lake.

Objective 1: Collect the data outlined in the study plan as necessary to understanding fish population dynamics in Moses Lake and to test the hypotheses.

Task 1.1 Collect biological data, including population estimates, age and size distribution, food consumption/predation rates, and standing crop estimates for all major fish species.

Task 1.2 Assess the availability and current use of spawning and rearing habitat for all major fish species.

Task 1.3 Collect detailed hydrological and limnological information during all periods of the year for two years.

Task 1.4 Monitor angling effort and harvest.

Task 1.5 Identify and implement management measures during the data collection phase if it is likely that subsequent results would test hypotheses or if longer monitoring periods are desirable.

Objective 2: Develop management actions based on valid hypotheses which will result in restoring the desired fish populations to Moses Lake.

Task 2.1 Identify the true hypotheses.

Task 2.2 Devise management measures to effect the needed changes suggested by the true hypotheses.

Phase 3 - Implement management measures as prescribed in the comprehensive plan to restore recreational angling opportunities for bass, crappie, bluegill, perch and trout in Moses Lake.

Objective 1: Implement habitat improvement, population control and/or regulatory measures required to restore fisheries for target species.

Objective 2: Monitor fish population and habitat response to management intervention and utilize principles of adaptive management to achieve objectives.

Objective 3: Evaluation of the success of management actions, and a management plan for the future management of Moses Lake.

g. Facilities and equipment

Start-up costs for the project include an extensive list of equipment, among these some high cost items. Major equipment includes an electrofishing boat, truck, Hydrolab, small boat and motor, nets, and computers. Other major expenses will be annual costs and include field office and storage space (rented in Moses Lake as space at Columbia Basin Fish Hatchery was not available as previously supposed), travel, and lab fees for water quality analyses. An Enhancement Project Account will also be included as an annual budgetary item, though major expenses from this account are not expected to be paid out until the year 2003. Enhancement projects could be expensive items if habitat work or fish barriers are prescribed, and the Account is a means of retaining a relatively stable budget through the project's life.

h. Budget

Moses Lake Fishery Restoration Project Budget Items Explanation

ITEM	ESTIMATE by / COMMENTS
Personnel	WDFW Payroll / Oct 1998 hiring; listed is the top pay range for position classification, actual pay may be as low as $46,260 total for the Biologist 3 and $35,160 total for the Biologist 1's ($116,580 total all positions), depending on lateral transfers.
Travel - Mileage	WDFW Fiscal Office / Average 15,000 miles/annum based on local based employee experience.
- Per Diem	WDFW Fiscal Office/ Total Days for three employees. One WDFW workshop and training; one professional meeting - these positions are research oriented and it will behoove the project for the employees to associate with other researchers in the field. Union agreements also stipulate such if the employee desires.

Goods and Services

- 16" Boots — WDFW Contract Price
- Hip Boots — " " "
- Waders — " " "
- Shoes — " " "
- Rain Gear — " " "
- PFD's — " " " (Maximum electrofishing crew of 5)
- Office Supplies — Set up new office; based on experience.
- Water analysis — Based on average price per sample for yet unknown number of parameters.
- Office and Storage — Rent due Cascade Marina, Moses Lake
- Utilities — Includes initial phone hook-up in addition to monthly charges.
- Service, modifications, and repairs: Equipment service, modifications, repairs, tools to perform work, and unanticipated small items. Based on past work done on similar project.

Equipment

- Truck 3/4 ton PU — WDFW 4/98 Contract Price / Chevy HD, 4x4, **extended cab**
- Electrofishing Boat — Smith and Root 5/98 price list / Boat, motor, and trailer.
- Hydrolab
- Computers — Price quoted by WDFW computer services personnel for motherboard/cpu - pci w/ 512 on board pipeline cache, cpu - Intel IP-5 200 hz MMX, hard drive-3.2 G, Ram- 32 M SDRAM, Floppy- 1.44, Video- 2 mb EDO RAM, CD rom- int. 24X, Modem- int. 33.6 data/fax, Case- mid tower, Tape backup - 3.2 G internal Colorado, keyboard- 104 win '95, Mouse- micro/serial, Monitor 17" NI 0.28, OS- Win 95 OSR 2 or similar machine.
- Software — Corel Office 7 or MS Office Pro 97 and additional software for BPA/WDFW compatibility.
- Balance — Top loading, field grade; Sartorius
- Spring Scales — 5, 10, 20 kg for larger fish; Pesola
- Measuring Board — Backlit, custom built for WDFW
- GPS/Depthfinder — For electrofishing boat; Lowrance or equivilent
- Nets All net prices based on previous purchases from Research Nets, Seattle
  - Fyke nets — 5 - 4' hoops w/ 100' leads and 50' wings, anchors, ropes
  - Gill nets — Variable mesh (1.5 - 2.0 - 2.5 - 3.0") 100' sinking.
  - Plankton — For Clarke Bumpus sampler
- Boat, motor, trailer — In general, a 16' open boat w/ some storage, and a 25-30 hp motor. Exact model of craft not yet determined; primarily for netting surveys, but will also be needed for other projects (see below)

Enhancement Project Account - As work progresses, it is expected that capital project-type enhancements will be apparent, and it will be desirable to initiate these projects as soon as possible so that their evaluation may become an integral part of the study plan. Examples of these projects might include fish barriers, net pens, artificial habitat, fish attractors, or the purchase of

commercially produced fish, among other possibilities yet unknown.

Section 9. Key personnel

Project Personnel: One Project Manager (Fish Biologist 3) and two Fish Biologist 1's are expected to be hired by January 1, 1999.

Existing Supervisory Personnel: The technical representative for WDFW and overall supervisor for the project is WDFW Regional Fisheries Program Manager, Joe Foster. Mr. Foster has been a Biologist with WDFW for 26 years, the last 16 years as Regional Fisheries Program Manager. He is very familiar with the issues and resources of Moses Lake and has vast experience managing projects and budgets. Field operations are directly supervised by WDFW District 5 Fisheries Biologist, Jeff Korth. Mr. Korth has a background in fisheries research and management for 16 years and has had fisheries management responsibility for much of the central Columbia Basin, including Moses Lake, since 1989. He has conducted regular biological surveys on Moses Lake since 1991 and has been intimately involved with the proposal since its inception.

Section 10. Information/technology transfer

The results of this project will be published in technical progress reports. Some scientific publication may be considered depending on the nature and uniqueness of the results. All data will be incorporated in WDFW's Stream and Lake Database. Public workshops will be held to keep anglers, other user groups, and the local citizenry abreast of our progress and to involve the public in management decisions. The project is likely to receive considerable media attention due to the economic and social importance of the Moses Lake recreational fishery.